

Geographic Variations and Taxonomic Status of *Myotis myotis* (Borkhausen, 1797) in Turkey (*Chiroptera: Vespertilionidae*)

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Abstract: This study is a taxonomical evaluation of 146 specimens of *Myotis myotis* (Borkhausen, 1797) collected in Turkey between 1974 and 1994. Turkish *Myotis myotis* were compared with records from the Palearctic Region. It was determined that both *Myotis myotis myotis* and *Myotis myotis macrocephalicus* are distributed in Turkey. The diagnostic characters, habitat, pelage colour, external and cranial measurements and distribution of each taxon were recorded.

Key Words: *Myotis myotis*, subspecies, taxonomy, Turkey

Türkiye'deki *Myotis myotis* (Borkhausen, 1797)'in Coğrafik Varyasyonları ve Taksonomik Durumları (*Chiroptera: Vespertilionidae*)

Özet: Bu araştırma, 1974 ve 1994 yılları arasında toplanan 146 *Myotis myotis* örneğinin taksonomik bir değerlendirmesidir. Türkiye'nin *Myotis myotis*'leri Palearktik Bölgeden verilen kayıtlarla karşılaştırıldı. Türkiye'de *Myotis myotis myotis* ve *Myotis myotis macrocephalicus*'un herikisinin yayılış gösterdiği tespit edildi. Herbir taksonun ayrıncı özellikleri, habitatı, kürk rengi, dış ve kafatası ölçüleri ve yayılışı verildi.

Anahtar Sözcükler: *Myotis myotis*, alttür, taksonomi, Türkiye.

Introduction

It has been recorded that 30 bat species exist in Turkey (1–12). Of these species, 29 feed on insects and one feeds on fruits. One of the bat species distributed commonly in Turkey is *Myotis myotis* (Borkhausen, 1797). This species was first recorded by Satunin (2) and is one of the largest insectivorous bats in the country. It has been recorded in Turkey by several researchers including Kahmann and Çağlar (4, 6), Corbet and Morris (13), Albayrak (14), and Steiner and Gaisler (12).

The two valid subspecies of *Myotis myotis* have been recorded in the Palearctic Region. The nominate form ranges within Europe and *M. m. macrocephalicus* ranges within the Middle East. Harrison (5) has shown the province of Antakya to be within the distributional area of *M. m. macrocephalicus* on account of the measurements of four *M. myotis* recorded by Kahmann and Çağlar (4). Felten et al. (8) have determined two specimens from the district of Hatay to be *M. m. macrocephalicus* and stated that *M. m. macrocephalicus* may be distributed throughout Anatolia. Steiner and Gaisler (12) have recorded five specimens from NE Turkey as the nominate form. The distributions of subspecies in Turkey have not been precisely determined due to insufficient material.

The purpose of this study is to determine the geographic variations of *Myotis myotis* and their distribution in Turkey.

Materials and Methods

A total of 146 *Myotis myotis* specimens are deposited in the mammalian collection of the Department of Biology, Faculty of Science, University of Ankara and collected by Albayrak between 1974 and 1994. Only adults were used for comparisons. Age determination was made following the methodology described by Andersen (15), Young (16) and Baagoe (17). The secondary sexual differences between adult males and females were examined statistically and 6 external and 11 cranial measurements of each specimen were recorded together with weight. For each taxon, the diagnostic characters, habitat, pelage colour, measurements, collection localities and specimens examined were recorded. The nomenclature of colours given by Ridgway (18) was also taken into consideration in defining the colour of the specimens. The bacula were prepared according to the method described by Topal (19). Diagnostic characters quoted by Harrison and Lewis (20) were used to distinguish the subspecies. In this

preliminary study, since Anatolian specimens could not be evaluated at subspecies level they were called “form”.

Results

Myotis myotis myotis (Borkhausen, 1797)

1797. *Vespertilio myotis* Borkhausen, Deutsche Fauna, I. p. 80.

Type locality: Germany

1897. *Myotis myotis* Miller, Ann. Mag. Nat. Hist., 20 (6): 383.

Diagnostic characters: Forearm, 55.9–58.2; greatest skull length 23.6–25.0; condylobasal length, 21.7–23.5; zygomatic breadth, 14.9–15.5; interorbital constriction, 5.1–5.4; braincase breadth, 10.6–11.1; maxillary tooththrow length, 8.8–10.5; mandibular tooththrow length, 10.6–11.2; mandible length, 17.8–19.0 mm (Fig. 2 and 4).

Habitat: It lives in caverns and crevices of walls in caves. *M. m. myotis* forms mixed colonies with *M. blythi*. It starts to hibernate in November.

Pelage colour: Dorsal colour is pale greyish brown and ventral colour is greyish dirty yellow.

Measurements: External and cranial measurements of *M. m. myotis* are given in Table 1.

Collection localities and specimen examined (n=11): Caves of Sinanköyü, Lalapaşa, province of Edirne (11 ♂♂) (Fig.1)

Myotis myotis macrocephalicus Harrison and Lewis, 1961

1961. *Myotis myotis macrocephalicus*, Harrison and Lewis, J. Mamm. 42 (3): 373.

Type locality: 2 km E of Amchite, Lebanon.

Diagnostic characters: Forearm length, 59.0–65.6; greatest skull length, 25.0–26.8; condylobasal length, 23.2–24.9; zygomatic breadth, 15.5–16.5; interorbital constriction, 5.0–5.6; braincase breadth, 10.0–11.4; maxillary tooththrow length, 10.5–11.2; mandibular tooththrow length, 11.3–11.9; mandible length, 19.3–20.6 mm (Fig. 2 and 4).

Habitat: It lives in large caves, frequently in sympatry with *M. blythi* and *Miniopterus schreibersi*. It starts to hibernate in January.

Pelage colour: Dorsal colour varies from very slightly brown tending to grey to pale yellowish brown–grey provided that the head and neck varies from paler whitish grey to paler yellowish grey, ventral colour varies from slightly yellowish ash grey to yellowish dirty white provided that the throat and chest varies from whitish dirty grey to yellowish dirty white. Measurements: External and cranial measurements of *M. m. macrocephalicus* are given in Table 2.

Collection localities and specimens examined (n=33): Karacaoğlan mağarası, Düziçi (4 ♂♂); Toprakkale, Osmaniye (1 ♂) province of Adana; Karanlık mağara,

Measurements	n	range	\bar{x}	SD
Total length	11	133.0 – 147.0	139.4	4.43
Head and body length	11	86.0 – 95.0	89.3	3.00
Tail length	11	46.0 – 52.0	50.0	2.34
Hindfoot length	11	17.0 – 18.0	17.3	0.50
Ear length	11	26.0 – 28.0	27.1	0.88
Forearm length	5	55.9 – 58.2	56.9	1.01
Greatest skull length	10	23.6 – 25.0	24.6	0.48
Total skull length	11	23.4 – 24.4	23.9	0.48
Condylobasal length	11	21.7 – 23.5	22.7	0.46
Zygomatic breadth	11	14.9 – 15.5	15.2	0.18
Interorbital constriction	11	5.1 – 5.4	5.1	0.10
Braincase breadth	11	10.6 – 11.1	10.7	0.16
Mastoid breadth	11	10.8 – 11.3	10.9	0.16
Skull height	8	9.6 – 10.3	9.9	0.25
Maxillary tooththrow length	8	8.8 – 10.5	10.0	0.53
Mandibular tooththrow length	10	10.6 – 11.2	10.9	0.20
Mandible length	10	17.8 – 19.3	18.6	0.40
Weight	11	24.0 – 32.0	28.0	2.32

Table 1. External and cranial measurements and weight of adult males of *M. myotis myotis* from Turkey; number of individuals (n), range, mean (\bar{x}) and standard deviation (\pm SD).

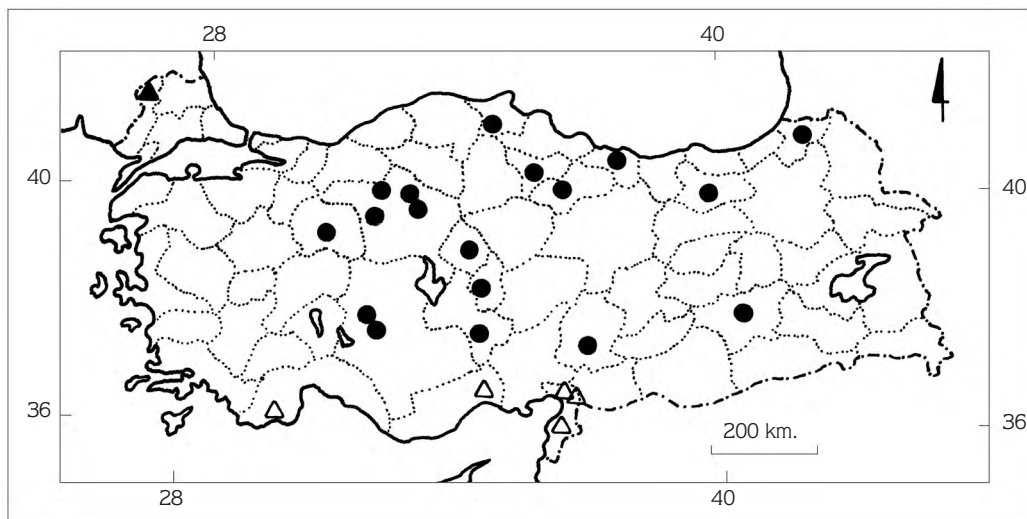


Figure 1. The collection localities of *M. myotis myotis* (▲), *M. myotis macrocephalicus* (△) and form (●).

Measurements	n	range	\bar{x}	SD
Total length	31	127.0 – 148.0	141.0	4.58
Head and body length	31	76.0 – 95.0	90.0	4.40
Tail length	31	47.0 – 58.0	50.7	2.15
Hindfoot length	31	15.0 – 18.0	17.2	0.68
Ear length	30	25.0 – 29.0	27.7	1.03
Forearm length	27	59.0 – 65.6	62.3	1.44
Greatest skull length	32	25.0 – 26.8	25.9	0.42
Total skull length	32	24.3 – 26.1	25.1	0.43
Condylbasal length	32	23.2 – 24.9	24.0	0.39
Zygomatic breadth	31	15.5 – 16.5	16.0	0.27
Interorbital constriction	32	5.0 – 5.6	5.3	0.15
Braincase breadth	32	10.0 – 11.4	10.9	0.33
Mastoid breadth	28	11.0 – 11.8	11.3	0.21
Skull height	25	10.0 – 11.3	10.4	0.34
Maxillary tooththrow length	29	10.5 – 11.2	10.7	0.19
Mandibular tooththrow length	29	11.3 – 11.9	11.5	0.17
Mandible length	31	19.3 – 20.3	19.7	0.27
Weight	32	23.0 – 41.0	28.7	3.62

Table 2. External and cranial measurements and weight of adult males and females of *M. m. macrocephalicus* from Turkey; number of individuals (n), range, mean (\bar{x}) and standard deviation (\pm SD).

Narlıca village, province of Antakya (19♂♂); Hıdırellez mağarası, Kaş, province of Antalya (1♀, 2♂♂); Sayköyü, Tarsus, province of Mersin (2♀♀, 4♂♂) (Fig. 1).

Discussion

In the first description of *Myotis myotis* from Germany, Borkhausen (21) recorded that the dorsal

colour was “light ash grey tinged yellowish”, the ventral colour was “brown grey, the base of hair was “blackish”, the nose was “yellowish brown”, the tip of the ears and the flight membranes were “brown”. Miller (22) recorded specimens from central and southern Europe as being broccoli brown and wood brown on the back and slightly yellowish grey white on the belly. Ognev (23) described the general tone of *M. myotis* as “grey smoky brown, ventral parts rather light dirty whitish with light straw admixture; roost slate grey and tips pale brownish, ears

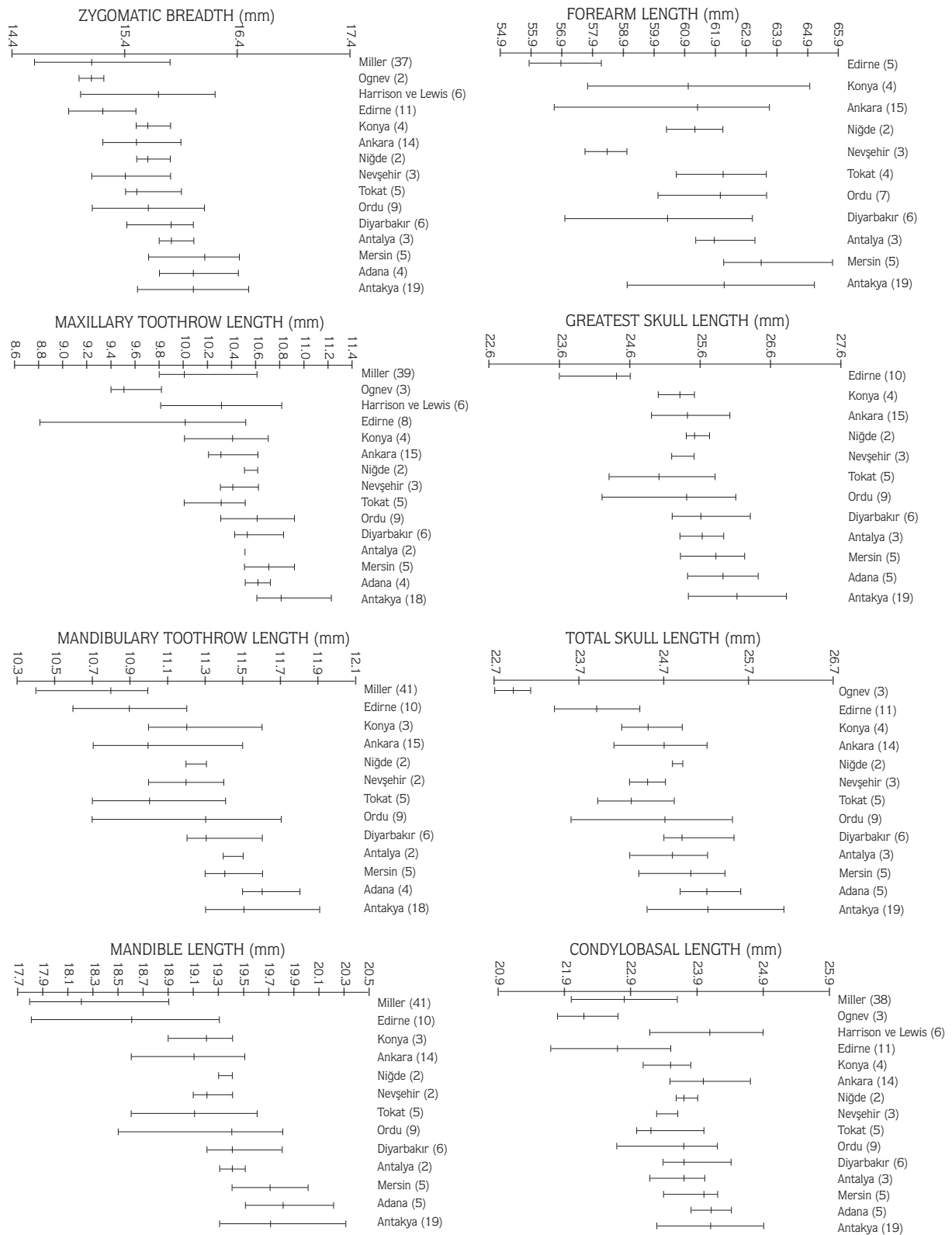


Figure 2. Comparison of populations of *Myotis myotis* from Europe (Miller, 1912), Russia (Ognev, 1928), the Middle East (Harrison and Lewis, 1961), and Turkey.

and flying membrane brown". Our specimens exhibited more of less similar coloration to the above authors' description in both dorsal and ventral colour.

In comparison of our material with Miller (22) and Ognev's (23) data concerning external and cranial measurements, only the data of specimens from Edirne (in Turkish Thrace) which is the nearest in Turkey to type locality, is within the range of the nominate form (Fig. 2). Harrison and Lewis (20) compared 49 specimens from Lebanon and Syria with specimens obtained from Germany, The Netherlands, Switzerland and Hungary. They distinguished a new subspecies of *Myotis myotis macrocephalicus* based on the values of specimens from Lebanon and Syria being greater than those of European samples (Fig. 2). Lewis and Harrison (24) have recorded the range of external and cranial measurements of 39 specimens of *macrocephalicus* from Lebanon. Harrison (5) and Harrison and Bates (25) have recorded the morphometric data of *macrocephalicus* from the same series adding one specimen from Israel once more. Furthermore, they determined the specimen from Antakya to be *macrocephalicus* based on the measurements quoted by Kahmann and Çağlar (4).

Morphometric data of *macrocephalicus* quoted by Harrison and Lewis (20) were compared with those of our material and only the specimens from the Mediterranean Region (provinces of Antalya, Mersin, Adana and Antakya) appear to be larger than the nominate form in terms of most morphometric values. Harrison and Lewis (20) have determined the variation limits of some measurements as follows: zygomatic breadth is 15.5–16.1; maxillary tooththrow length,

10.0–10.6; mandibular tooththrow length, 10.8–11.3. The values of our material from the provinces in the Mediterranean Region for the same measurements are statistically significantly greater ($P < 0.05$) than those given by Harrison and Lewis (20) (Fig. 2).

Kahmann and Çağlar (4) have compared 21 *Myotis myotis* specimens from Gökçeli (İstanbul) with the European specimens recorded by Miller (22). They have noted that there was no difference in the measurements except forearm length which was bigger in Turkish bats (range=60.0–68.2 versus 61.0–63.6). The forearm length is 55.9–65.6 mm for all specimens from Turkey except those from Edirne which have the corresponding values of 55.9–58.2 mm. This difference could be the result of the slight difference in measurement techniques.

Myotis myotis ranges in Europe, Russia, Caucasus, Asia Minor, Mediterranean Islands and the Middle East (22, 23, 26, 20, 27–31) (Fig. 3).

Felten et al. (8) have stated that there was a gradual increase in the size of *Myotis myotis* specimens from Central Europe to Eastern Mediterranean (Fig. 4).

Felten et al. (8) have determined two specimens from the province of Antakya to be *macrocephalicus*. Thus the distribution of this subspecies might extend to the SW coast of Anatolia. They conclusively emphasized that the distribution of *macrocephalicus* had not yet been determined and more specimens from Eastern Anatolia were needed to explain the taxonomic status of *M. myotis*. Steiner and Gaisler (12) have determined four specimens of *M. myotis* to be the nominate form based on their smaller values of cranial measurements of Arabic

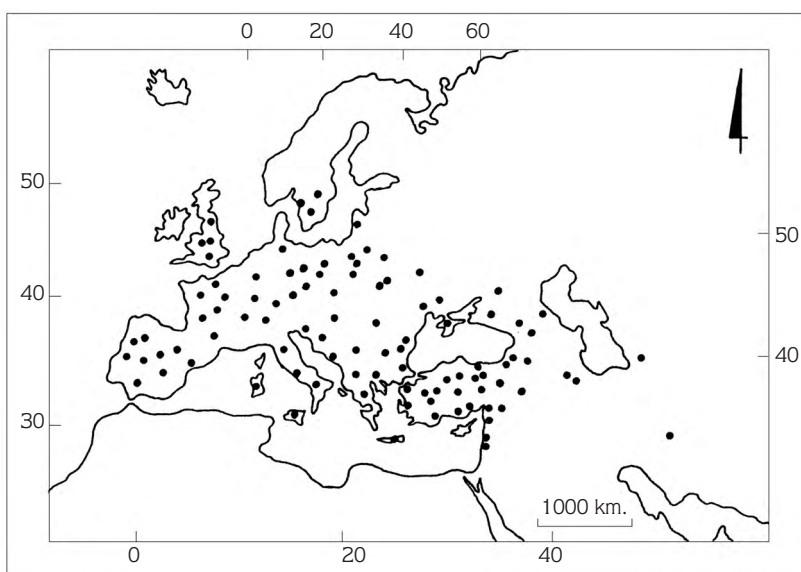


Figure 3. Distribution of *M. myotis* (●) in the Palearctic Region.

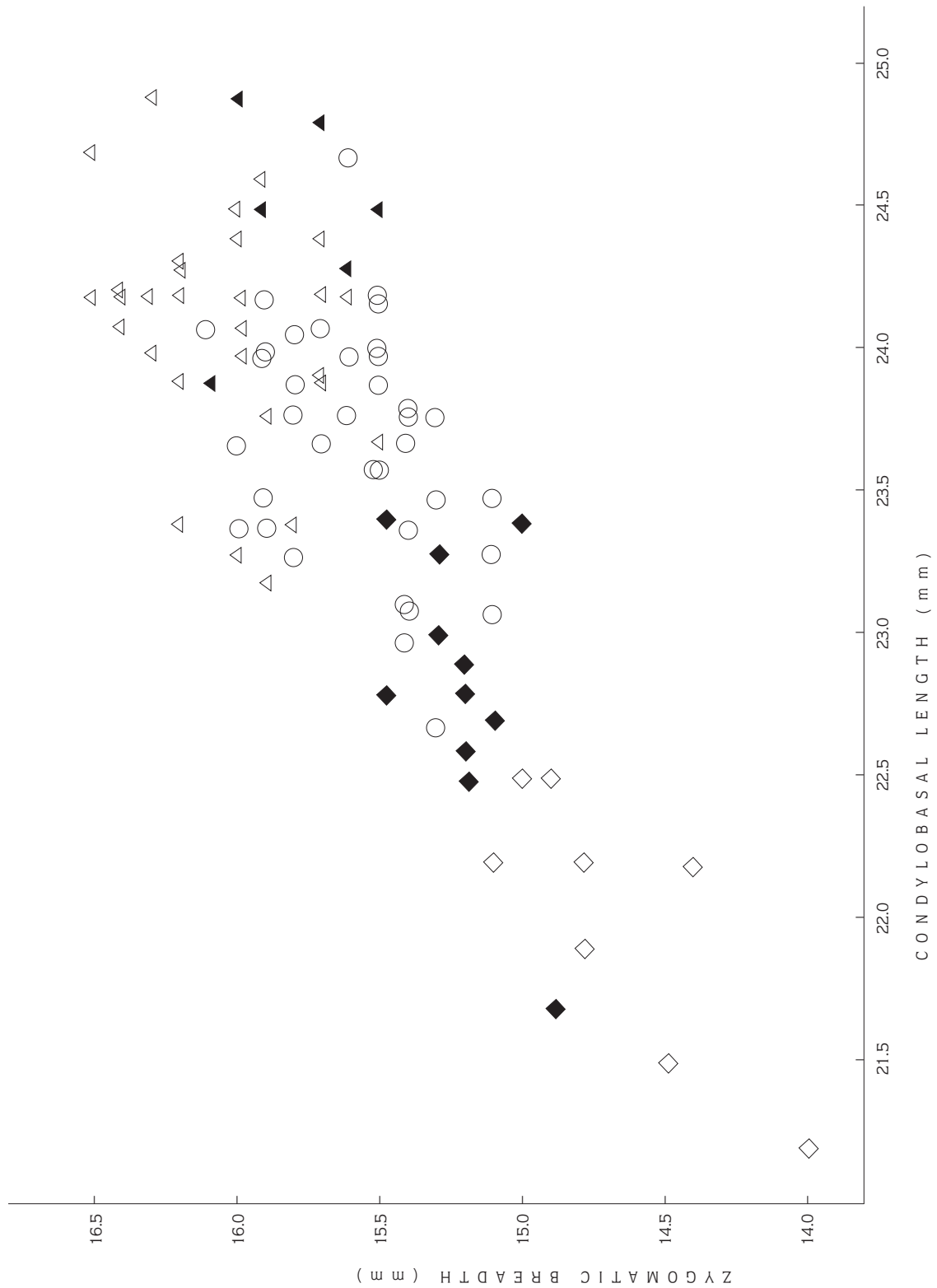


Figure 4. Scatter diagram showing condylobasal lengths and zygomatic breadths in different populations of *Myotis myotis* [Europe (◇) (Miller, 1912); the Middle East (▲) (Harrison and Lewis, 1961) and Turkey [◆: Edirne;△: Antakya, Adana, Mersin, Antalya;○: Anatolia]]

macrocephalicus quoted by Harrison and Lewis (20) and Harrison and Bates (25).

Specimens from Edirne exhibit more or less similar coloration to those from Antalya, Mersin, Adana and Antakya in both dorsal and ventral colours including paleness. In addition, data for specimens from the latter localities are significantly greater than those of specimens from Edirne in terms of forearm length, greatest skull length, total skull length, condylobasal length, zygomatic breadth, mastoid breadth, skull height, maxillary tooththrow length, mandibular tooththrow length and mandible length (Table 1 and 2).

In five specimens of bacula from Edirne, the variation limits of the length and the width are 0.80–0.92 mm and 0.48–0.64 mm; the corresponding values for the specimens from Mersin and Antakya, are 0.72–0.88 mm and 0.48–0.56 mm respectively. Bacula are also similar in

shape as well as in size for the specimens from both localities compared above (Fig. 5).

A total of 30 bacula was examined and their values overlapped with those of 19 bacula from Hungary recorded by Topal (19) (Table 3). It can be concluded that the baculum is not diagnostic in size and shape for the subspecies.

Looking at the specimens from a considerable part of Anatolia, it can be argued that Anatolian specimens have similar characteristics to both subspecies in Turkey. Similarities first appear to be in dorsal and ventral coloration between Anatolian specimens and both subspecies. Marked similarities are also detected in the bacular shape and size between them (Fig. 5 and Table 3).

Morphometric values of Anatolian specimens (Table 4) lie in the range of lower and upper limits of nominate

	width				length			
	n	range	\bar{x}	SD	n	range	\bar{x}	SD
<i>Myotis myotis</i> (Hungary)	19	0.50–0.68	0.57	–	19	0.88–1.12	0.98	–
<i>Myotis myotis myotis</i> (Edirne)	5	0.57–0.72	0.63	0.06	5	0.90–1.04	0.97	0.05
<i>M. myotis macrocephalicus</i> (Antalya, Mersin, Antakya)	16	0.51–0.69	0.61	0.04	16	0.83–1.12	0.98	0.07
<i>Myotis myotis</i> (Konya, Kırşehir, Nevşehir, Ordu, Diyarbakır)	9	0.56–0.74	0.62	0.05	9	0.85–1.14	0.98	0.08

Table 3. Bacular measurements of *M. m. myotis* from Hungary (Topal, 1958) and Turkey.

Measurements	n	range	\bar{x}	SD
Total length	48	123.0 – 148.0	138.2	5.35
Head and body length	48	76.0 – 96.0	87.5	4.28
Tail length	48	44.0 – 58.0	50.6	3.19
Hindfoot length	47	12.0 – 18.0	17.0	1.13
Ear length	47	17.0 – 31.0	23.7	2.17
Forearm length	42	56.7 – 64.9	61.0	2.05
Greatest skull length	47	24.3 – 26.4	25.4	0.42
Total skull length	46	23.6 – 25.6	25.1	3.13
Condylobasal length	45	22.7 – 24.7	23.7	0.39
Zygomatic breadth	45	15.1 – 16.1	15.6	0.25
Interorbital constriction	47	4.9 – 5.5	5.2	0.14
Braincase breadth	47	10.0 – 11.3	10.7	0.36
Mastoid breadth	47	10.3 – 11.7	11.0	0.20
Skull height	44	9.8 – 10.7	10.2	0.23
Maxillary tooththrow length	41	10.0 – 10.8	10.4	0.18
Mandibular tooththrow length	48	10.5 – 11.7	11.2	0.23
Mandible length	45	18.5 – 20.2	19.2	0.32
Weight	44	20.0 – 35.5	27.9	4.58

Table 4. External and cranial measurements and weight of adult males and females of *M. myotis* from Anatolia; number of individuals (n), range, mean (\bar{x}) and standard deviation (\pm SD).

form and *macrocephalicus* respectively (Fig. 2). In general, the morphometric values of specimens gradually increase from Turkish Thrace (Edirne) through the district of Hatay (Fig. 2). This result is in accordance with the findings given by Felten et al. (8).

It was acceptable, relying on diagnostic characters given by Harrison and Lewis (20), that the nominate form and *macrocephalicus* in Turkey were distinctively separate as two different subspecies. However, specimens from the major part of Anatolia, first evaluated in the present study have filled the gap between these two, raising the point previously made by Koopman (32) that *macrocephalicus* is a synonym. The specimens from a few provinces, having similar characteristics in some measurements to both nominate form and *macrocephalicus* might be presumed to support this idea. Nevertheless, the remaining major part of Anatolia still appears to be outside this presumption. This leads us to consider that Anatolian specimens might be determined

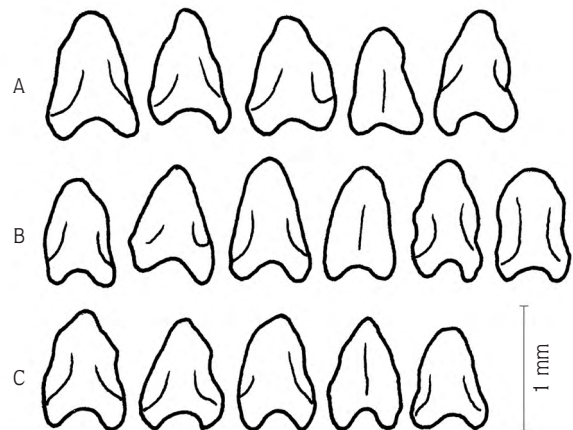


Figure 5. The dorsal view of bacula *M. myotis myotis* (A), *M. myotis macrocephalicus* (B), and form (C).

to be another form. Our sceptical approach about the status of *macrocephalicus* could only be clarified by the investigation of more specimens.

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